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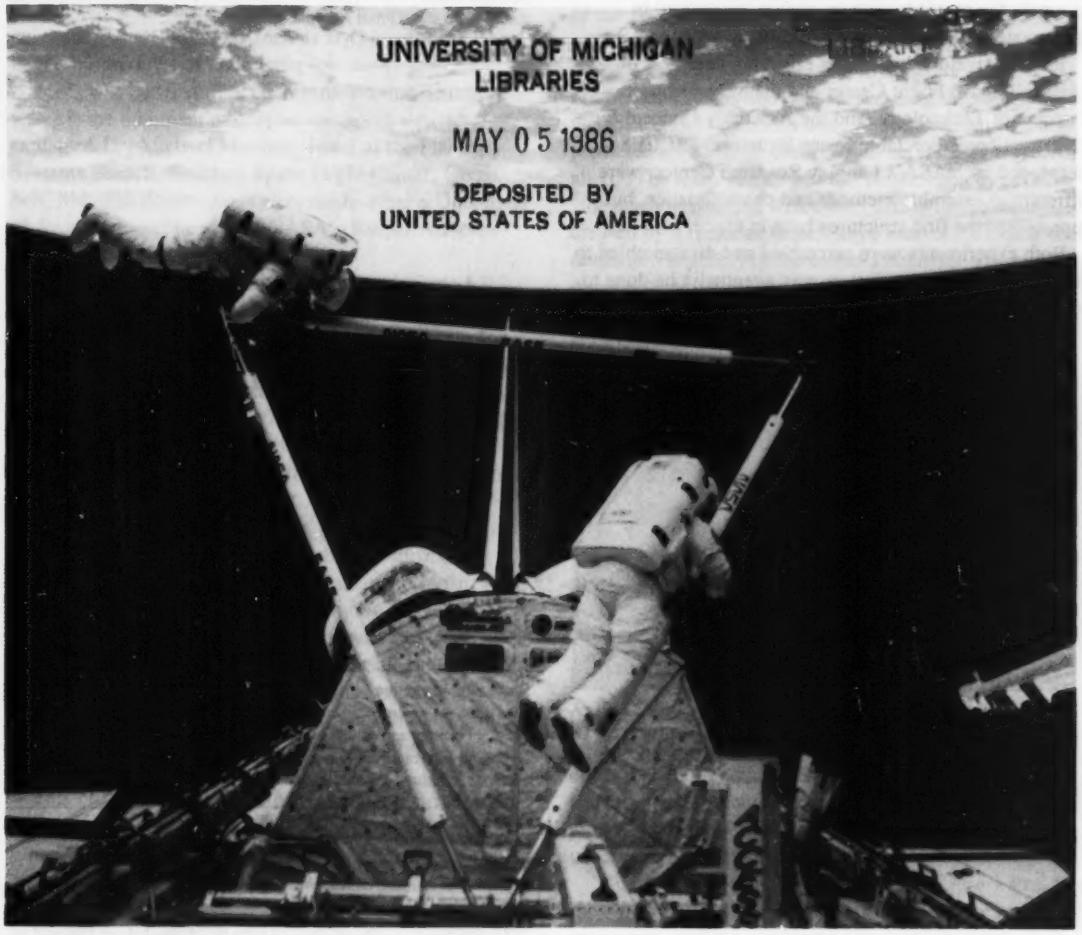

"The NASA can-do spirit is intact . . . we are going to get back on the track of exploring and exploiting space"—Associate Administrator for Space Flight, Rear Admiral Richard H. Truly.

About The Cover

During mission 61-B, launched November 26, 1985, astronauts Jerry Ross and Sherwood Spring assemble the Experimental Assembly Structures in Extravehicular Activity (EASE).

EASE was a geometric structure that looked like an inverted pyramid composed of a few large beams and nodes. Crew members moved about during EASE assemblies, rather than working in fixed positions.

The primary objective of the EASE experiment was to study how people work during space construction and compare the methods used in orbit to those used in underwater training in neutral buoyancy facilities.

EASE, developed in a joint effort between NASA's Marshall Space Flight Center and the Masssachusetts Institute of Technology, and the Assembly Concept for Construction of Erectable Space Structures (ACCESS), developed by NASA's Langley Research Center, were different in assembly methods and characteristics, but represented the first structures built in space.

Both experiments were assembled and disassembled to form larger structures, just as may eventually be done to build the Space Station.

Contents

Scientists Make First Definite Identification Of Water In Comets	3
NASA Postpones Galileo, Ulysses, Astro-1 Launches	4
Deputy AA For Space Science Named Distinguished Executive	5
Remote Sensing Agreement Reached By NASA And ESA	5
United States And United Kingdom Sign Research Agreement	6
Engineer Develops Improved Turbulence Model	6
Significant Scientific Results Produced By Spacelab 3 Mission	7
Samples Of 51-L Mail From Around The World	8, 9
Dr. Robert W. Brown Named Director Of Educational Affairs	10
Interior Designates 22 "Man In Space" National Landmarks	11
From The Congressional Record	13
Contractor News	14
Did You Know?	15
Another Dividend From Air And Space	16

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Dwayne C. Brown
Editor, Code LFD-2
NASA Headquarters
Washington, D.C. 20546
Phone: (202) 453-8400

Scientists Make First Definite Identification Of Water In Comets

A team of NASA and university scientists observing comet Halley in December 1985 have made the first direct confirmation of water in a comet.

The discovery, the first definite detection of neutral water in any comet, lends new support to astronomers' widely held theory that comets are "dirty snowballs" composed primarily of frozen water. The theory was first developed by astronomer Fred Whipple in 1951, but has only received indirect corroboration to date through discoveries of atoms such as oxygen and hydrogen, molecules such as OH and ions such as H_2O+, supposed to be the by-products of underlying ice.

"This was our first direct confirmation that neutral water is the dominant molecular species in a comet," explained Dr. Michael Mumma, Head of the Planetary Systems Branch, Goddard Space Flight Center, Greenbelt, Md. The observations were made using a University of Arizona telescope aboard NASA's Kuiper Airborne Observatory.

The discovery stems from a new theoretical model developed at Goddard by Mumma and Dr. Harold Weaver, now an associate research scientist at the Center for Astrophysical Sciences, Johns Hopkins University, Baltimore, Md. The theory, which Mumma conceived and first presented in March 1980 at a conference on planetary spectroscopy, holds that the parent molecules can best be detected by measuring their infrared fluorescence spectrum stimulated by sunlight.

The theory has been developed extensively since then by the two astrophysicists and has been confirmed by independent work of scientists in France and Japan. It predicts in precise detail the wavelengths and relative intensities of infrared spectral lines emitted by gaseous water and other parent molecules in comets.

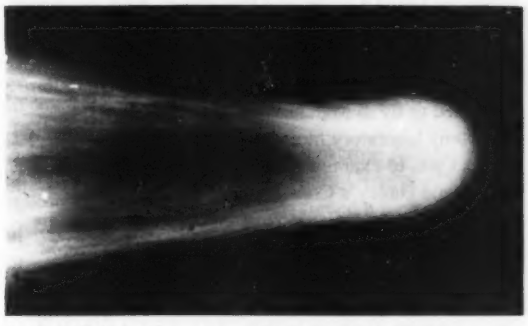
The theory also predicts that a definitive study of cometary water is not possible from conventional ground-based telescopes because of spectral line absorption by water in our own atmosphere.

This problem was minimized by using an airborne telescope and special instrumentation developed at the Lunar and Planetary Laboratory of the University of Arizona by Dr. Harold P. Larson, Dr. D. Scott Davis and Michael Williams. The Arizona group specializes in airborne spectroscopic studies of solar system objects, a program which produced, for example, the detection of water in Jupiter's atmosphere 10 years ago.

The Arizona spectrometer was used to observe comet Halley on the nights of Dec. 21, 22 and 23, 1985. The flying observatory consisted of a 36-inch diameter telescope in a modified C-141 aircraft, operated by NASA's Ames Research Center, Mountain View, Calif. Observations were made at an altitude of 41,000 feet, far above that of any conventional ground-based telescope, to reduce interference by terrestrial water vapor.

Soviet and European spacecraft encountering comet Halley also will be looking for water. "Although NASA did not send a spacecraft through comet Halley, as far as the confirmation of water is concerned, the use of the Kuiper observatory was the most cost-effective way this country could have solved this central problem in cometary science," according to Larson. "This facility and its dedicated staff deserve equal recognition for the success of our project."

The theory accurately predicted the presence of 10 spectral lines of water in Halley's cometary coma, a bright cloud of gas and dust surrounding the cometary nucleus. Observations on Dec. 21 showed four of the 10 predicted lines, while observations on Dec. 23 revealed all 10. The team saw more lines on the last day because "the brightness of the water lines across the board increased by a factor of three," says Weaver. "Finding such dramatic variability in the comet's behavior was a surprise in itself." Comet variability, he notes, has been observed previously by teams observing their atomic composition and brightness.



A view of Halley's Comet from an Earth ground observatory.

Astronomers have been seeking to confirm the presence of water in comets for more than 20 years, first using radio astronomy telescopes and later satellites, such as the International Ultraviolet Explorer (IUE), that observe in the ultraviolet spectrum.

"These attempts largely have failed because water, like most polyatomic molecules, does not fluoresce in the ultraviolet, and the new theory shows that water's radio spectral lines are too weak to be seen," according to Weaver.

The direct detection of a major parent molecule ushers in a new era of direct investigations of the compositions of cometary nuclei and of the physics of cometary coma.

Until now, scientists had to work backward, using the known fragments to infer the identities of plausible parent molecules.

This process was highly uncertain because many potential candidates could have produced the observed fragments, but it was impossible to identify any specific precursor. This discovery demonstrates that astonomers now have a powerful new tool for predicting and detecting, with accuracy, parent molecules in comets including gaseous water and other constituents.

The NASA/university team plans to observe comet Halley again, March 21 through 27 from the Kuiper observatory in Australia, both for water and methane, in an effort to compile the first complete map of a cometary coma for these substances.

NASA Postpones Galileo, Ulysses, Astro-1 Launches

NASA postponed the Ulysses mission to investigate the poles of the sun and the Galileo mission to orbit Jupiter and send a probe into that planet. Both spacecraft were scheduled to be launched by the Space Shuttle in May.

The agency also will not launch the Astro-1 mission, scheduled to fly in March. Astro-1 is an ultraviolet astronomy laboratory mounted in the Shuttle's payload bay that was to examine quasars, "hot" stars, galaxy centers and Halley's Comet.

The decisions on Galileo and Ulysses were made by Dr. William R. Graham, NASA Acting Administrator, after consultations with senior officials of the German Research and Technology Ministry and the European Space Agency. Graham said the decision not to launch in May "does not reflect a judgement that the resumption of Space Shuttle launch operations would necessarily be postponed until after the launch opportunity for either Galileo or Ulysses."

Graham said the decision took into account two principal factors:

"1. Key personnel required to assure a safe and successful launch of either Galileo or Ulysses are preoccupied with the timely analysis of causes of the 51-L accident.

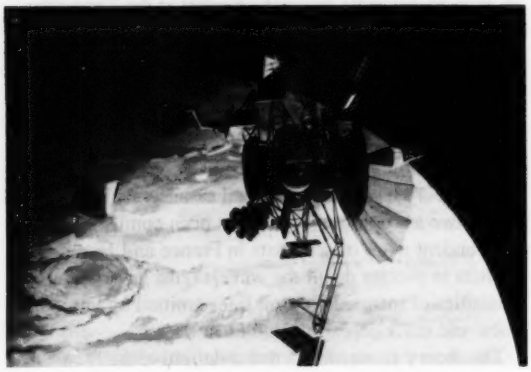
"2. The consequences of the accident have significantly eroded the schedule margins for launch site processing required prior to the first flight of the Shuttle/Centaur upper stage."

An upper stage is a rocket attached to the spacecraft. It is used to boost a spacecraft on its mission from low-Earth orbit after it has been deployed from the Space Shuttle. Two orbiters were modified to carry the missions, Atlantis and Challenger. Challenger was destroyed in the accident on Jan. 28.

Although the missions have been postponed, NASA will proceed with planned tests to ensure that all interfaces between the spacecraft, their upper stages, the Shuttle and the launch facilities are validated prior to launch.

Revised launch dates will be determined after a schedule for resumption of Shuttle launches has been established.

Due to their trajectory requirements, both the Galileo and Ulysses missions are dependent on the relative positions of Jupiter and the Earth at launch time. (Ulysses also must be sent to Jupiter to get a gravity assisted boost to reach the sun). Jupiter must be almost directly on the opposite side of the sun from Earth at the time of launch if it is to be in the required location at the time of spacecraft arrival. This geometric arrangement occurs once every 13 months. Therefore, for a direct launch to Jupiter, both missions would be delayed at least 13 months until another favorable launch window occurred.



This painting shows the Galileo orbiter releasing its atmospheric probe.

Astro-1 had to be launched in the March-April time frame to observe Halley's Comet. With that opportunity gone, a new, specific launch date request for the mission has not yet been established.

However, scientists are anxious to get the mission into space because of the observatory's capabilities. In addition to the unique ultraviolet observations it can make of celestial objects, Astro-1 could complement the observations of the Hubble Space Telescope. It is capable of wide-field observation of the heavens. Scientists would use these observations to select the most interesting targets for detailed investigation by the Space Telescope.

A new launch date will be selected in the future.

Deputy Associate Administrator For Space Science And Applications Named Distinguished Executive

Samuel W. Keller was recognized by the President of the United States in a December 12 ceremony at the Old Executive Office Building with the "Rank of Distinguished Executive". Mr. Keller was cited for his outstanding leadership, meritorious service, personal dedication, technical excellence, and significant contributions of major importance to many of the nation's space flight programs. His creativeness, fairness and consistency, and meticulous attention to major elements of both administrative and technical programs has resulted in a true NASA career of distinction.

In October 1985, at the NASA Headquarters Annual Honor Awards Ceremony, the NASA Administrator awarded to Sam Keller the highest achievement a NASA employee may receive—the NASA Distinguished Service Medal. He was presented the following citation which read: "For providing the highest level of executive leadership in managing the Nation's Civilian Space Science and Applications Programs. Your technical and administrative skills and deep insight into the dynamics of organizational behavior have contributed in a fundamental way to the Agency's long-term capabilities for effective program and project management."

Mr. Keller has been associated with NASA since 1960 when he joined the Goddard Space Flight Center. Subsequent assignments have spanned the management spectrum within the agency. After five years at the Goddard Space Flight Center, Mr. Keller was named Deputy Director for Administration and Management (1965) and, in 1972, was named Director of Administration and Management. In 1975 Mr. Keller transferred to NASA Headquarters as Assistant Administrator for Personnel Programs and was the line official responsible for planning, directing, and managing all aspects of the Agency's programs related to personnel utilization and development. He was then requested by Dr. Frosch, the incoming Administrator, to chair a committee charged with developing a new organizational structure for NASA Headquarters. The intent of this effort was to streamline the decision-making process and reduce the number of organizational elements reporting to the Administrator's office. Evidence that this was accomplished was seen in the 40% reduction in the Administrator's span of control. Major changes were also made in the alignment of Headquarters staff positions. After these organizational concepts were approved, Mr. Keller was appointed Deputy Associate Administrator for Space and Terrestrial Applications. On February 20, 1981, Dr. Calio, the Associate Administrator for Space and Terrestrial Applications, was tasked to an assignment as Acting NASA Deputy Administrator until leaving the Agency in November 1981. During this period, Mr. Keller was charged with the full responsibility for all aspects of the Space and Terrestrial Applications program which had a budget of approximately one-half billion dollars.

In December 1981, Mr. Keller assumed the duties of Deputy Associate Administrator for Space Science and Applications in the newly combined organization, the position he occupies today. Mr. Keller has clearly demonstrated a career of maximum contribution and accomplishment. He has excelled in every assignment and has left behind organizations that are stronger and more efficient as a result of his management expertise and technical competence.

Remote Sensing Agreement Reached By NASA And ESA

Dr. William R. Graham, NASA Acting Administrator, and Professor Reimar Luest, Director General of the European Space Agency (ESA), signed a memorandum of understanding on NASA/ESA cooperation in connection with the first European Remote Sensing Satellite (ERS-1).

Under the memorandum, ESA agreed to permit direct readout of ERS-1 Synthetic Aperture Radar (SAR) data for U.S. government research purposes at the Fairbanks, Alaska, station that NASA is developing in connection with its Navy Remote Ocean Sensing Satellite System Scatterometer (NROSS) program. In addition to the C-band SAR, ERS-1 will have a C-band scatterometer, radar altimeter, microwave sounder and a precise positioning system.

ERS-1 is planned for launch in 1989 and will have a 3-year projected lifetime with the possibility of a second flight unit to be launched in 1992/93.

Under the agreement, NASA also will exchange its scatterometer and radar imagery for other ERS-1 data of interest. The data received from ERS-1 should enhance

NASA-supported polar ice research and complement NASA experimental activities related to NROSS, the Topography Experiment for Ocean Circulation (TOPEX) and Shuttle Imaging Radar-C, all of which are projected to operate in the same timeframe as ERS-1.

The agreement maintains a tradition of remote sensing collaboration between NASA and ESA for the benefit of the international research and application user community. In permitting NASA direct data readout from ERS-1, ESA reciprocates similar provisions made by NASA for European data readout from the Seasat and Nimbus-7 spacecraft.

United States And United Kingdom Sign Research Agreement

The United States and the United Kingdom signed a memorandum of understanding for a cooperative research program addressing an advanced short takeoff and vertical landing (ASTOVL) aircraft concept.

The memorandum was signed by Dr. William R. Graham, NASA Acting Administrator, and Dr. Donald A. Hicks, Under Secretary for Research and Engineering, Department of Defense, for the United States. Sir David Perry, Chief of Defence Equipment Collaboration, signed for the United Kingdom.

The broad objective of the agreement is to create an environment which encourages collaboration between the United States and United Kingdom governments and their industries to develop technology for ASTOVL aircraft. The aim is to reduce the technological risk associated with potential future ASTOVL combat aircraft. These aircraft will have the capabilities of an advanced supersonic fighter aircraft with the added advantage of landing vertically when necessary.

The research program will investigate four propulsion concepts: vectored thrust, ejector augmentor, tandem fan and remote augmented lift system. The program will assess the relative potential as well as the joint research required for advancement of these technologies to future ASTOVL aircraft.

The two governments envisage the possibility of undertaking a joint experimental aircraft activity that could lead to the production of new generation ASTOVL aircraft, should there be a requirement for such aircraft. Should the joint work be undertaken, it will be covered by separate agreements.

Engineer Develops Improved Turbulence Model

A major breakthrough in turbulence modeling has been reported by engineers at the Marshall Space Flight Center.

While working on developing turbulence models for computational fluid dynamics codes, Dr. Chien-Pin Chen, a National Research Council associate working the the Center's Systems Dynamics Laboratory, developed a multiple-scale turbulence model.

"Turbulence is the random or chaotic motion of liquids or gases that occurs when fluid velocities are high or the physical size of the flow is large," said Chen. Highly turbulent flow occurs inside the Space Shuttle main engine and influences heating, combustion, engine durability, and performance.

According to one of Chen's co-workers, Dr. Warren Campbell, "Turbulence is one of the great unsolved problems of science. Mathematical tools that permit accurate prediction of turbulent flows of liquid or gases are presently not available. This has led to a lot of trial and error based engineering design for fluid handling systems. This is especially true when the designs are revolutionary or push the state of the art."

Dr. Chen reviewing notes on his work.

A classic example of this was the development of rockets, according to Campbell, adding that good mathematical models can reduce the amount of trial and error engineering, or ground testing, which must be done.

"Chen's multiple-scale turbulence model is not the final answer to turbulence modeling," said Campbell, "but it represents a significant advance in the state of the art. For the first time some very complex flows have been accurately predicted."

Chen's method is an extensive revision of an earlier model developed by two widely recognized authorities in

the fluid dynamics community—Dr. Brian Launder of the University of Machester Institute of Technology and Dr. K. Hanjalic of the Masinski Fakultet, Sarajevo, Yugoslavia. The earlier model failed to reduce to a simpler form under simple conditions, and the result was a loss of accuracy, according to Chen. With the new model the earlier shortcomings were eliminated.

Chen's model has wide applicability to all types of turbulent flows. The improvement in predictive capability for turbulent flows means reduction in development costs of many high technology products. Those systems for which turbulence plays a major role in manufacture or in performance will be most affected. Examples include advanced propulsion systems like the Space Shuttle main engine, erosion affected structures, and chemical polymerization products. "Also, our understanding of natural phenomena, such as tornado dynamics, and dust effects on atmospheric effects on atmospheric processes will be improved," said Campbell.

"Eventually, the Chen method could result in improvements in the performance of internal combustion engines, including the Shuttle main engine; better designs for dams, canals and other structures where erosion is a problem; longer lasting nonstick coatings of frying pans; and higher quality plastic products."

Significant Scientific Results Produced By Spacelab 3 Mission

Research carried out during the Spacelab 3 mission produced some significant preliminary scientific results, according to mission scientist Dr. George H. Fichtl of the Marshall Space Flight Center in Huntsville, Ala. Researchers and participants in the 7-day Space Shuttle flight gathered at the center to present their initial findings.

"The mission has made some major contributions in the physical and life sciences," said Fichtl of the Center's Systems Dynamics Laboratory. "We have gained a lot of insight for future Spacelab and Space Station research. And I think we can now say that space research is becoming routine."

"Initial results from the three Spacelab 3 crystal growth experiments are very promising," said Fichtl, lead scientist for the Marshall Center-managed research mission. The two tryglycine sulfate crystals and the single mercuric iodide crystal grown aboard the space laboratory were at least as good as the best crystals grown on Earth to date. And they may actually be better, but additional testing will be required to confirm this, according to Fichtl. "This is of major significance, because normally, we must grow between one and two thousand crystals on Earth to get just one crystal that is equal to the quality of those grown on Spacelab 3. Mercuric iodide crystals have application in X-ray detectors, and triglycine sulfate crystals are used in infrared detectors."

Additionally, the methods used to grow the crystals in orbit were proven during the flight. Triglycine sulfate crystals were grown from a solution, as part of an experiment provided by Alabama A&M University in Huntsville. The mercuric iodide crystal was grown using a vapor transport process in an experiment provided by EG&G Energy Measurements Inc. of Goleta, Calif.

The third crystal growth experiment, which also used mercuric iodide and was provided by France, performed as expected and added to scientists' knowledge about the process of crystal nucleation. This is a different process to study on the ground because of gravity-induced convection, according to Fichtl.

The fluid physics experiments also provided new information. The Drop Dynamics Module that was repaired during the flight by principal investigator and payload specialist Dr. Taylor Wang enabled researchers to do some experiments not possible on Earth. Results of the experimentation confirmed some of the theories on how drops behave when rotated. This was the first opportunity to test some theories posed centuries ago by scholars, including Sir Isaac Newton.

The experiment also proved that the use of sound waves is a viable technique for manipulating liquids in a microgravity environment. This has direct application to containerless materials processing in space. This technique allows the processing of materials without incurring the contaminating effects introduced by the container. From the flight, it was learned that the "acoustic bottle" or "crucible of sound" in which the droplet is contained, had much better characteristics than had been theorized. "And this is good news for the containerless processing," said Fichtl.

Drop dynamics experiments confirmed theories on how drops behave when rotated slowly. However, experiment data violated some basic theories relating to the behavior of drops being rotated at higher rates. It was found, for example, that drops tend to transition (change) to a new shape at rotation rates lower than had been predicted. "All this tends to indicate that some of our theories may need to be modified," said Fichtl. The Drop Dynamics Module experiment was developed by the Jet Propulsion Laboratory.

continued on page 10

Messages of Encouragement, Condolenc

KSC Director Dick Smith told fellow space workers recently, there has been "a great outpouring, not only of sympathy, but also of support from all over the world" in the aftermath of the 51-L tragedy.

The messages have come from friends made by NASA officials' recent visit to China, and from heads of state and individuals around the globe, he noted.

Here are a few samples from that great body of humanity of all ages brought closer by their shared loss.

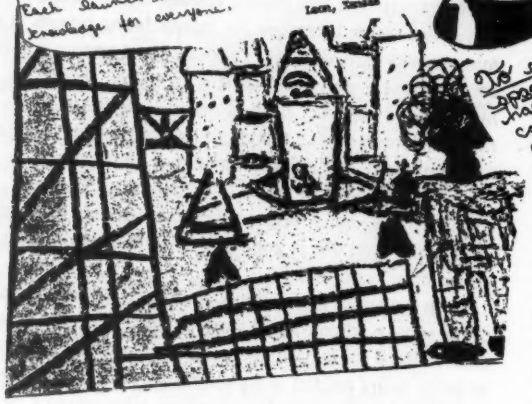
THE ATRONOMICAL SOCIETY OF SOUTH AUSTRALIA EXTENDS DEEPEST TO FAMILIES AND FRIENDS OF THE INCREDIBLY BRAVE PEOPLE THEIR
LIVES IN THE CHALLENGER TRAGEDY. TO ALL AT NASA WE ENCOURAGEMENT FOR THE CONTINUENCE OF YOUR MAGNIFIC ACHIEVEMENTS

NASA's ground crew
Shuttle- O.V. -C99 Challenger ✓

As heroes behind the scenes, I wish to tell you that you have an dang a great job. Give launches in space shuttle missions and several rockets without a hitch.. I've watched many of these with great interest.

Each mission we spend. Each one has something new to explore, maybe a satellite to launch, or a space walk. Each learned helps new experiences and new knowledge for everyone.

Leon, Kansas



I cried today for once not for myself,
But for the ship and crew of Challenger
And all the people that they knew.

Honolulu, Hawaii

February 3, 1986.

To N.A.S.A.

So they after math of the Space Shuttle tragedy, we'll see more polls saying should we have more manned spaceflights? I say yes. Please don't go on and fix the shuttle and do greater things in space with more than ever before.

Eliot Mich

CLINTON, CONNECTIC

Director
John F. Kennedy Space Cen

Dear Sir;

May I extend to you,
NASA involved in our spac
and most sincere sympathy

The adventurer in ea
the shuttle this morning
final rendesvous with dea
it our hopes, our dreams
Because we are a nation b
ience that is uniquely Am
program, our shuttle prog
must continue. What bette
pay our fallen heros?

Thank you for your t

To everyone at the cape canaveral space center. We are very sad what happened but we believe in you. carry on the good work and maybe one day we'll be able to work for you.

Good Ideas

age 10

Raworth
Hampshire
UK

We, because I feel I represent the views of the vast majority of English people, want you to continue with more resolve than ever to continue the manned exploration of space. There is no robot capable of experiencing discovery as man will do, and those that suggest unmanned flight are missing the whole point, its not a technical argument as Discoverer is proving, its about hearts and minds and the ability one day for ordinary people to follow, just as they did Raleigh, Livingstone, Drake and Scott.

They too paid the price, but the mantle of these great explorers resides with you and your team. We know you will continue to carry it with pride and fortitude.

We are behind you 110% of the way, for what its worth.

THE ELLINGTON HIGH SCHOOL CHAPTER OF THE NATIONAL HONOR SOCIETY WISHES TO EXTEND ITS SINCEREST REGRETS ON THE DEATH OF THE SEVEN ASTRONAUTS.

WE WOULD ALSO LIKE TO EXPRESS, AS STUDENTS, OUR DEEPEST APPRECIATION TO ALL THE ASTRONAUTS WHO HAVE, AND WILL AGAIN, RISK THEIR LIVES IN THE PURSUIT OF FURTHERING OUR KNOWLEDGE OF SPACE

ELLINGTON CT

ences Sent To NASA From The Nation, World

NTON, CONNECTICUT

y Space Center

tend to you, and all those at
in our space program, my deepest
ere sympathy
turer in each of us was aboard
is morning when it made it's
us with destiny, taking with
our dreams and our prayers.
a nation blessed with a resil-
uniquely American, our space
huttle program in particular,
. What better tribute can we
heros?
for your time.

Dear NASA,

As a U.S. citizen, I've had a strong urge to write you on the terrible tragedy of the Challenger Crew on Jan.28th. I was watching from my office as it all was happening and continued to follow all of the news casts afterwards.

I just wanted to say, that even though it was a devastating event and all our hearts went out to the Crew and all their families, I too feel that NASA was not at fault. I try to follow all the space launches and sometimes find myself getting frustrated at all the delays. I know how cautious NASA has been and I feel anger when some try to put the blame on you. I hope the space program will continue in honor of the seven crew members. I know they all looked forward to the flight and would have wanted it to continue.

I for one have not changed my feelings on space travel and if NASA is ever looking to put the first Diabetic in space, please remember my above address and send me an application. Our flag is half staff and everytime I see it I'am reminded of this tragic day. But, if given the chance, I wouldn't hesitate the chance to go.

Please don't cut out civilian space travel. Let us decide if we want the opportunity to see the stars and Earth from space.

KEEP UP THE EXCELLENT WORK!

I've been out walking and walking in the snow. I am so devastated and felt I wanted to reach out to you and your colleagues who worked on this mission. My thoughts and prayers go out to you. My sincere concern and pride for all of you is boundless. May God give you strength. I know that you feel this tragedy more any of us

1/28/86

Dear Nasa,
Please don't give up be... Neptune, N.J.
need to go to different planets, I
think their was a leak in the fuel
tank, because of the freezing weather.
It is important that we continue to
explore space.

love,
Age 8 grade 3
Chula Vista, Ca.

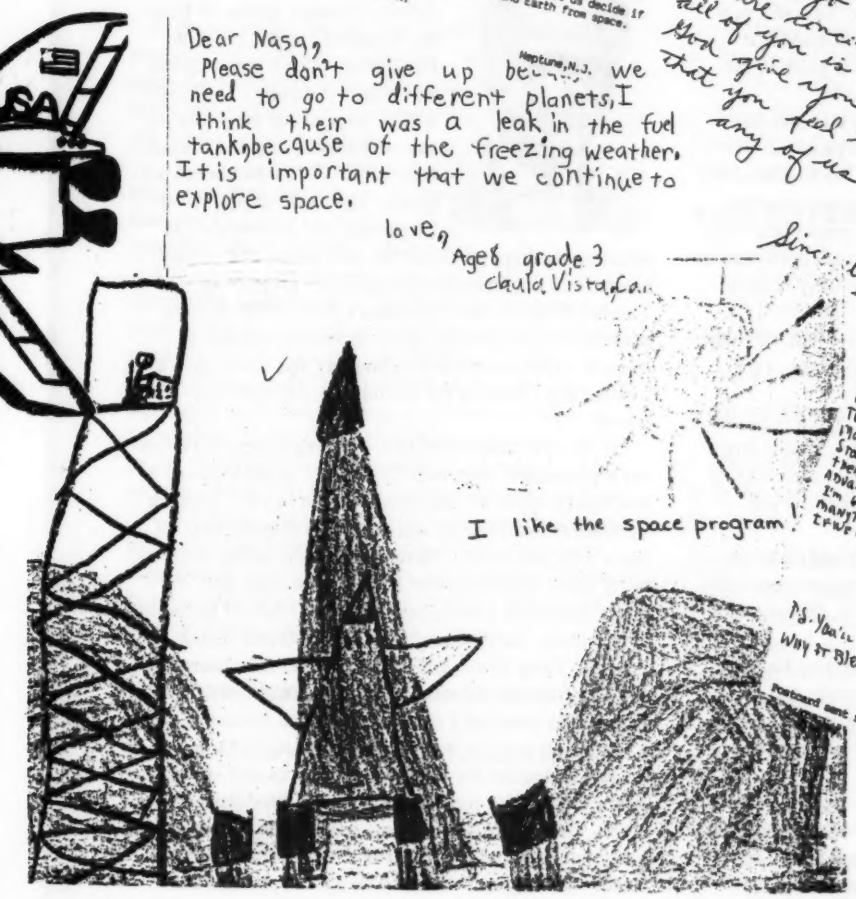
Sincerely,

Springfield, Mass.

Don't Give Up Shuttle 1/28/86
Program. Regardless Of Loss
To-day You Must Go Forward.
That's Destiny. It's To Go To The
Stars. Id Populate The Planets.
There Will Always Be Losses In
Advances.
I'm 69 & I've Seen The World Turn
Many Times & I Always Have Hope!
I Have Wish To Make Things Better.
Don't Give It Up.

P.S. You'll Find The Answer
Why It Blew Up.

Postcard sent from Northridge, Calif.



Researchers for the Geophysical Fluid Flow Cell Experiment reported that all 102 hours of their data looked good, and is expected to lead to a better understanding of the dynamics of stellar interiors and planetary atmosphere.

Many of the results confirmed existing theories of convection. It was noted by the research team, however, that at higher heating rates—such as those that may be found on the sun—the date showed some interesting and significant departures from what had been anticipated. Since the mission, researchers have been able to successfully develop computer models of some of this new information.

"In the area of atmospheric research and astronomy, the Atmospheric Trace Molecules Spectroscopy (ATMOS) experiment, sponsored by the Jet Propulsion Laboratory, also produced some fantastic results," said Fichtl. For the first time, researchers were able to simultaneously measure the concentrations of chemical compounds associated with carbon, nitrogen, oxygen and other chemical cycles in the atmosphere. This will provide a better insight into the chemical processes that govern the distribution of minor and trace gases in the atmosphere between 10 and 100 kilometers.

The instrument worked so well that it was able to record concentrations of gases as low as parts per 100 billion. This is significant, because it is the first time we have been able to make such sensitive measurements, reported Fichtl. And, for the first time, researchers were also able to detect and measure traces of nitrogen pentoxide. This compound had heretofore been undetected in the atmosphere, but was predicted to be present.

The instrument also provided some data that will help researchers understand the gaseous regions above the surface of the sun.

The aurora experiment recorded data on every planned pass, and accumulated 274 color photographs and five hours of video recordings. The spectacular pictures that are still being analyzed have already revealed some structures not previously observed.

The Studies of the Ionization of Solar and Galactic Cosmic Ray Heavy Nuclei (IONS) instrument reportedly worked well, and research teams in India, the sponsoring nation, are still processing their data.

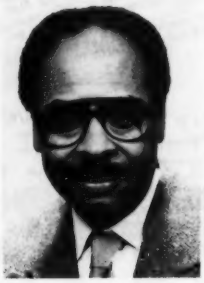
Results from the Research Animal Holding Facility showed that the system worked well overall, and researchers learned a lot about how to operate the facility on future flights. Only minor modifications will be required to the facility.

Researchers concluded that the apparent case of space adaptation syndrome in one of the monkeys supports the contention that this species will be a good model for future studies of vestibular adaptation in microgravity. Researchers reported that both primates are alive and well and residing at the Ames Research Center, the organization responsible for the Research Animal Holding Facility experiments.

Results from studies of the largest group of rats flown aboard a single spacecraft showed their hind muscles were 11 to 36 percent smaller and the bones were less strong after their space flight.

Other researchers are still reviewing their initial data, according to Fichtl.

Dr. Robert W. Brown Named Director, Educational Affairs Division For The Office Of External Relations



Dr. Robert W. Brown has been appointed Director, Educational Affairs Division, Office of External Relations. In this position, Dr. Brown, whose appointment was effective January 13, 1986, will be responsible for providing executive leadership and management of NASA's educational programs. This will include the development and maintenance of effective working relationships with public and private educational communities through such projects as Teacher In Space and Operation Liftoff. Both of these projects are designed to stimulate student interest in science, mathematics and technology and could have a far reaching effect on the nation's educational community.

Dr. Brown comes to NASA from the Office of Personnel Management with over 25 years of federal service in five federal agencies. His career began in 1957 with the Veterans Administration and continued over the next 25 years with positions of increased administrative responsibility in the Department of Health, Education and Welfare's Bureau of Family Services, the Office of Economic Opportunity, the National Institute of Mental Health, the Alcohol, Drug Abuse and Mental Health Administration, and the Office of Personnel Management. In 1977, Dr. Brown was awarded a Brookings Federal Executive Fellowship and in 1979, he was appointed to OPM as Assistant Director for Consulting Services and later, Assistant Director for Performance and Productivity Programs. Dr. Brown was then assigned to the Federal Executive Institute (FEI) in 1982 as Associate Dean for Academic Programs where he designed, planned and

scheduled all of FEI's academic programs and provided oversight for educational activities. From January 1985 to the present, Dr. Brown has held the position of Assistant Director for the Office of Finance and Administrative Services, Administration Group, U.S. Office of Personnel Management.

Dr. Brown was born in Kansas City, Missouri. He graduated from Lincoln University in 1956 with a Bachelor of Arts degree in Sociology, a Masters degree in Psychiatric Social Work in 1958 from Atlanta University and a Doctor of Public Administration degree in 1981 from the University of Southern California. Dr. Brown and his wife, Myrtle, live in Rockville, Maryland. They have one son, Gregory.

Interior Designates 22 "Man In Space" National Historic Landmarks

Secretary of the Interior Don Hodel designated 22 properties in Alabama, California, Maryland, Mississippi, New Mexico, Ohio, Texas and Virginia, as national historic landmarks representing the early years of the American space program.

"These designations represent the best, most intact and most important examples of the technology which will interpret for future generations the early years of the American space program," Hodel said.

The Interior Department's National Park Service, as directed by Congress (P.L. 96-344), studied approximately 350 sites associated with the early space explorations for preservation and interpretation. "A Man in Space Theme Study" was initiated to consider resources relating to the following general subthemes: technical foundations before 1958; the effort to land a man on the moon; the exploration of the planets and solar system; and the role of scientific and communications satellites.

The Historic Sites Act of 1935 authorizes the Secretary to designate as national historic landmarks properties identified as having significance to the Nation. National historic landmarks are entered in the National Register of Historic Places upon designation.

Designated National Historic Landmarks

National Advisory Committee for Aeronautics Wind Tunnels

1. Variable Density Tunnel, Langley Research Center, Hampton, Va.
2. Full Scale Tunnel (Langley)
3. Eight-Foot High Speed Tunnel (Langley)
4. Unitary Plan Wind Tunnel, Ames Research Center, Moffett Field, Calif.

These sites represent the technological base of aeronautical research created by the National Advisory Committee for Aeronautics facilities.

Rocket Engine Development Facilities

5. Rocket Engine Test Facility, Lewis Research Center, Cleveland, Ohio
6. Zero-Gravity Research Facility (Lewis)
7. Spacecraft Propulsion Research Facility (Lewis Plum Brook Operations Division)

These represent the important role of the Lewis Research Center in developing hydrogen as a fuel for the Centaur and Saturn V rockets.

Rocket Engine Test Stands

8. Redstone Test Stand, George C. Marshall Space Flight Center, Huntsville, Ala.
9. Propulsion and Structural Test Facility (Marshall)
10. Rocket Propulsion Test Complex, National Space Technology Laboratories, Bay St. Louis, Miss.

These facilities represent the role of the Marshall Space Flight Center in the building and testing of actual space flight rockets.

Rocket Test Facility

11. Saturn V Dynamic Test Stand, George C. Marshall Space Flight Center, Huntsville, Ala.

This facility illustrates another facet of the building and testing and man-rating of the Saturn V Rocket.

Launch Pads

12. Launch Complex 33, White Sands Test Facility, New Mexico

Launch Complex 33 was designated because of its close association with the testing of the V-2 rocket and the origins of the American Rocket Program.

Apollo Training Facilities

13. Lunar Landing Research Facility, Langley Research Center, Hampton, Va.
14. Rendezvous Docking Simulator (Langley)
15. Neutral Buoyancy Space Simulator, George C. Marshall Space Flight Center, Huntsville, Ala.

These facilities were designated because of their association with training programs necesssary to prepare American astronauts to land on the moon.

Apollo Hardware Test Facility

16. Space Environment Simulation Laboratory, Lyndon B. Johnson Space Center, Houston, Texas

This Laboratory is important because it was used to man-rate and test the integrity of the Apollo Command and Service Module, Lunar Module, and spacesuits under simulated space conditions here on Earth.

Unmanned Spacecraft Test Facilities

17. Spacecraft Magnetic Test Facility, Goddard Space Flight Center, Greenbelt, Md.
18. Twenty-Five-Foot Space Simulator, Jet Propulsion Laboratory, Pasadena, Calif.

These facilities illustrate the extensive ground support testing facilities needed to accomplish the American unmanned space program—the exploration of the near and deep space environment.

Tracking Stations

19. Pioneer Deep Space Tracking Station, Goldstone Tracking Station, Calif.

The station was the first antenna to support NASA's unmanned exploration of deep space.

Mission Control Centers

20. Space Flight Operations Facility, Jet Propulsion Laboratory, Pasadena, Calif.
21. Apollo Mission Control, Lyndon B. Johnson Space Center, Houston, Texas

These sites are the very heart and soul of both the American Manned and Unmanned Space Programs.

Other Support Facilities

22. Rogers Dry Lake, Edwards Air Force Base, Edwards, Calif.

Although a natural resource, Rogers Dry Lake was designated because of its association with flight testing of advanced aircraft that opened the way to space.

NASA Nets Meeting

A three-day meeting of the quality circles, NASA Employee Teams (NETS) Coordinators was held at Columbia Lakes Conference Center in West Columbia, Texas on December 10-12, 1985. The meeting was lead by the NASA NETS Program Manager, Dale Crossman, Code N, NASA HQ. A contractor training team from Martin Marietta Michoud assisted. Each center and headquarters were represented by a NET coordinator. Between October, 1984, the end of the pilot period and December, 1985 there was an increase in NETS from 117 to 167—an increase of 43 percent. The NETS exist among all personnel categories—Scientists and Engineers, Clerical, Professional/Administrative, Supervisor/Manager, Technician, Joint NASA/contractor, and contractor on and off site. Anyone interested in forming a NET for group problem-solving sessions should contact their local NET coordinator.

The participants pictured (left to right) are Skip Cole, **LaRC**; William Reynolds, **MSFC**; Ralph Tortorich, Martin Marietta Michoud **(MMM)**; Gene Guerny, **HQ**; Chris Dreyfus, **MMM**; Dale Crossman, **HQ**; Willa Gaitanis, **GSFC**; Mary Kovach, **LeRC**; Mark Rogers, **HQ**; Gene Bishop, **KSC**; Alma Martin, **JSC**; Herman Watts, **NSTL**; Vicki Calbert, **ARC**; Donald Carr, **MMM**; Steve Rohr, **MSFC** and Leo Lunine, **JPL**.

From The Congressional Record

Representative George E. Brown, Jr. provided the following remarks concerning the NASA FY 1987 budget proposal regarding TAV research:

In January, the Space Shuttle *Challenger* embarked on a mission of science and commerce. That mission abruptly ended in tragedy when the vehicle exploded 74 seconds into the flight. America lost seven pioneers that morning. For those millions who watched the tragedy live, or watched it later on tape, the names of the *Challenger* crew will be etched in our memories: Francis R. (Dick) Scobee, Michael J. Smith, Judith A. Resnik, Ronald E. McNair, Ellison S. Onizuka, Gregory B. Jarvis, Christa McAuliffe.

A reassessment of the Space Transportation Systems priorities will undoubtedly take place. My colleagues and I on the Science and Technology Committee will play a large role in that reassessment. Issues will be addressed as to the Shuttle launch priorities once it resumes operations. The Defense Department, for example, had been straining the capacity of the Shuttle even before Tuesday's Shuttle accident, reserving as much as one third of the Shuttle launch capacity. The Strategic Defense Initiative's R&D would put additional demands on the Shuttle capacity through the 1990's. Clearly, with a complement of four Space Shuttles NASA was just able to satisfy the needs of all U.S. customers. The loss of the *Challenger* has resulted in a substantial loss of total launch capacity which will not easily be regained.

To replace the lost orbiter at this point would cost between $1.7 and $2.2 billion, and would take from 3 to 5 years to complete. I personally support funding another orbiter as I have in the past, but other interim steps should be taken as well. For example, it may be cheaper and easier to reinvest in expendable launch vehicles to stem the U.S. launch-capability gap caused by the loss of the *Challenger*. Currently, the Shuttle is only supplemented by four expandable launch vehicles each year. In 4 years or so, the additional shuttle would again be available to handle the increased demand.

This is also an appropriate time to move forward with an advanced next generation Shuttle vehicle. I commend the administration for the farsightedness it has shown by proposing funding for transatmospheric vehicle [TAV] research effort in its fiscal year 1987 budget. NASA and the Department of Defense [DOD] would jointly be charged with researching the vehicle over a 2- to 3-year period. The TAV would achieve speeds of 25 times the speed of sound—Mach 25, the velocity needed to achieve Earth orbit.

The TAV, or National Aerospace Plane [NASP] as the Air Force has officially named it, would potentially drive down the cost of delivery payloads into space by a factor of 100. The flexibility of the hybrid vehicle would allow it to launch on demand and take off and land at major airports. The TAV has also been called the new Orient Express because it will have the ability to travel from the United States to anywhere on the Asian Pacific rim in a matter of a few hours. The possibilities for civilian, as well as defense uses of the aerospace plane are evident.

Within DOD, participants include the Air Force, Navy, the Defense Advanced Research Projects Agency [DARPA], and the Strategic Defense Initiative Organization. Funding for the initiative would be split approximately 80 percent and 20 percent between DOD and NASA, respectively. I am concerned that this funding structure is weighted too heavily on the military, but I will hold my reservations in check as long as first, the program remains a basic research initiative, and second, no military mission is imposed on the TAV during the research and development stages.

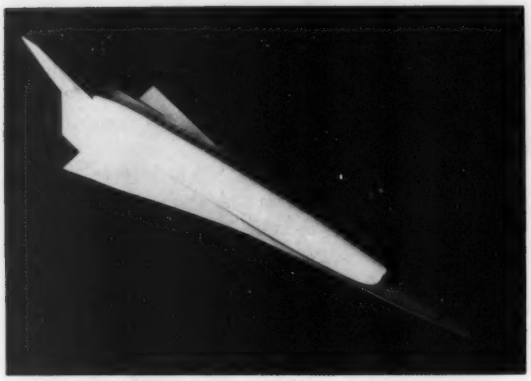
The proposed TAV requires a $300 to $400 million 2- to 3-year-ground-test program which would concentrate on advancing and demonstrating key engine, materials, and structure technology. NASA requested $42.8 million for the program in fiscal year 1987. Although the DOD contribution is classified, the Washington Post reported that a total of $200 million is requested for fiscal year 1987 activities. If the ground test phase progresses satisfactorily, a test vehicle could be built by the early 1990's for under $2 billion. If Congress will take up the challenge of investing in a TAV program, an operational TAV system could be possible by the year 2000. I fully support moving this program ahead.

Long after the burning issues of this Congress are forgotten, the latter half of the 20th century will be remembered as the era when the people took the first steps off this planet. Long after Gramm-Rudman-Hollings is forgotten, parents will tell their children about the first lunar landing, unmanned expeditions to the planets, and the start of routine travel to space. It is difficult to compare the benefits of the space program to any other federally funded program. How can Congress analyze the "aspirations," measure the "wonderment," or quantify the "hopes" that are the real benefits of America's space program?

Aside from the satellite industry, what we do in space

today may not show significant economic gains in the near-term. What we are investing in is a dream—a hope—which may not show material benefit for many years—far beyond the long-term projections of the most liberal economists. I am convinced that people will establish bases on the Moon and Mars, and eventually settle the entire solar system. From those far away colonies, men and women will undoubtedly begin to contemplate manned interstellar exploration. We will do these things because the urge to explore new territories and travel in space is basic to human nature. We cannot deny this ancient desire.

Most major discoveries in the past have been made by individuals who took up the scientific or exploratory challenge on their own. But, today's pioneers can't tinker in their garages and build a vehicle to take them to the stars. Therefore, we, as a nation, must become the curious star voyager and build those ships. As a collective inquisitor, the nation shares in the rewards of the discoveries made aboard ships like the *Challenger*.



A general concept of an Aerospace plane.

The President has asked for sufficient NASA fiscal year 1987 budget, and I would ask that you support a healthy program when it comes to the floor of the House for consideration.

This past year has been plagued with numerous natural and man-inflicted disasters, but none has touched the human spirit more than the explosion of the Space Shuttle *Challenger*. Carrying seven heroes, including America's first teacher in space, the loss will not soon be forgotten. However, the potential gains of exploring and developing space have not diminished with this accident. The hopes and aspirations of the crew of the *Challenger* are still very much a part of the consciousness of America. We must draw from this tragic experience renewed determination to explore space, and to make it a place in which all humans can one day safely travel.

Contractor News

The National Aeronautics and Space Administration signed a memorandum of understanding with **SPACEHAB, Inc.,** Seattle, Wash. The memorandum established a framework for cooperation in SPACEHAB's efforts to develop and market payload bay habitable modules that would augment the pressurized volume of the Space Shuttle.

The SPACEHAB modules would be truncated metal cylinders, 10 ft. long and 13 ft. in diameter, connected to the orbiter crew compartment airlock by tunnel adaptors. The modules would provide additional living and working space for astronauts to conduct experiments in the microgravity environment of space.

NASA and SPACEHAB agreed to enter into negotiations to reach agreement on a number of technical and other issues related to the use of SPACEHAB in the Shuttle. There will be no exchange of funds under the memorandum.

NASA's Marshall Space Flight Center in Huntsville, Ala., selected **Teledyne Brown Engineering** for negotiation leading to the award of a new five-year contract to provide for the operation and maintenance of the propellants and pressurants facilities for the Center. Total price for the first three contract years is approximately $8.8 million.

NASA's Goddard Space Flight Center, Greenbelt, Md., selected **Bell Aerospace Systems Division (BASD),** Boulder, Colo., for negotiation of a cost-plus-fixed-fee/award contract for the Space Telescope Imaging Spectrograph (STIS).

The contract is for Phase 1 (Definition) of the effort. Approval to proceed with Phases 2 and 3 (Development and Operations) will be contingent upon Goddard Space Flight Center being selected by NASA Headquarters for those phases.

The total proposed estimated cost and fees for the contract for all phases is $40,443,980.

The contract, awarded on February 17, 1986, will cover a period of approximately six and one-half years, from February 17, 1986 through June, 1992.

The contract will provide for the design, fabrication, test and support of the STIS, which is a second-generation Hubble Space Telescope Instrument. The effort will be performed primarily at BASD's facility in Boulder, Colorado, in support of Goddard's Space and Earth Sciences Directorate.

Did You Know?

In December 1985, the International Astronomical Union announced the naming of a minor planet discovered on November 6, 1964, at the Goethe Link Observatory, Indiana University. The planet was named after Dr. Nancy Grace Roman, a space-age astronomer who joined the staff of the National Aeronautics and Space Administration in 1959 and served in the space science area for two decades. Her earlier professional experience included positions at the Yerkes Observatory and the U.S. Naval Research Laboratory.

John K. Lauber, formerly Chief, Aeronautical Human Factors Research Office, Ames Research Center, was recently appointed by President Reagan as a member of the National Transportation Safety Board. Dr. Lauber, with NASA since 1973, has been responsible for internationally recognized research into the causes of human error in aviation. Prior to his departure from NASA, Dr. Lauber was awarded the NASA Medal for Outstanding Leadership for his direction of a large international study of the effects of jet lag on pilots in international air transport.

NASA Lewis Research Center Director Andrew J. Stofan was presented the 1985 Presidential Rank Award to distinguished Executives at the White House on December 12 for his career-long achievements in managing advanced research and technology programs for NASA.

The Westlake, Ohio resident also recived a $20,000 stipend as a result of being selected to receive the Presidential award.

Productivity Meeting Held

A two-day productivity meeting was held by the NASA Senior Executives Committee at Honeywell Inc. in Minneapolis, November 20-21, 1985. The first day was devoted to briefings by Honeywell executives on their productivity improvement and quality enhancement programs, followed by a closed NASA meeting on the second day to review the status of the previous year's productivity programs in the agency. The group made plans and set action items for the initial phase of the NASA Productivity Demonstration Project. The participants pictured are (front row, left to right): Wayne Young, **JSC;** Frank Penaranda, **HQ;** Glen Hogan, **Honeywell Inc.;** Richard Wisniewski, **HQ;** Ray Arnold, **HQ;** Dr. Mary Ann Donahue, **Honeywell;** Gaylord Nickols, **JPL;** C. L. Vignali, **Honeywell;** Fred Povinelli, **HQ;** Dr. Lynwood Randolph, **HQ;** Warren Ahtye, **ARC;** and Feliza Kepler, **Honeywell.** (Second row, left to right): William Kelly, **JSC;** Richard Reeves, **ARC;** Fred Felberg, **JPL;** Russ Ritchie, **HQ;** John Langmead, **GSFC;** Tom Campbell, **HQ;** John Klineberg, **LeRC;** Robert Goetz, **JSC;** Charles Force, **HQ;** Gene Guerny, **HQ;** Jim Coakley, **Honeywell;** B. A. Brock, **Honeywell** and John Heie, **JPL.** (Back row, left to right): Leroy Hopkins, **HQ;** David Braunstein, **HQ;** Lewin Warren, **HQ;** Warren Camp, **KSC;** Woody Bethay, **MSFC;** Joe Malaga, **KSC;** Frank Hoban, **HQ** and Bill Williams, **LaRC.**

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Vehicle Controller

For the Apollo lunar landings of the early 1970s, NASA developed a Lunar Rover to permit exploration of the moon miles from the immediate vicinity of the landing site. The Rover was designed to allow an astronaut to drive one-handed, using an airplane-like joystick to accelerate, brake and steer the vehicle. That technology is being applied to a system that offers severely handicapped people an opportunity to drive highway vehicles, providing them mobility for more productive lives.

Called UNISTIK, the system is being developed by Johnson Engineering Corporation, Boulder, Colorado under the joint sponsorship of NASA and the Veterans Administration Rehabilitation Engineering Research and Development Service, Washington, D.C. The UNISTIK vehicle control system employs a joystick that combines the functions of steering wheel, brake pedal and throttle pedal, thus can be operated by handicapped persons who have no lower limb control and only limited use of upper extremities. The driver simply moves the joystick forward to accelerate, backward to brake and from side to side for steering; any combination of these movements can be used. The UNISTIK control is shown in the lower photo; it is undergoing extensive testing in a Ford van, pictured at right during a demonstration in Washington, D.C.

The UNISTIK system is designed as an addition to an ordinary van. The patented modification utilizes digital electronics, microprocessors and high-torque actuators—one each for brake, throttle and steering—all easily installed entirely under the dashboard as a "bolt-on" accessory. The installation allows full use of the vehicle's normal controls by able-bodied persons; a push of a button switches from regular to UNISTIK control or vice versa. Under way since 1981, the project is now in its final development phase, expected to culminate in production of the system beginning in March.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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